

ATTACHMENT G

Local-Scale Spatial Variability of PM_{2.5} Concentrations for Selected Metropolitan Areas

Attachment G complements Attachment F by examining the spatial variability of 1999 PM_{2.5} concentrations at a local level. By increasing the resolution to the MSA, it is possible to examine local-scale phenomenon that may not be easily observed when looking at the entire nation. The approach used here is to calculate linear correlation coefficients for each possible pair of sites and plot these as a function of distance in a correlogram (see Attachment F for more detail on this approach). Several restrictions are used to screen data from certain pairs of sites.

- Only sites within the metropolitan area are considered, and only MSAs where there is more than one point plot are included
- Only sites that had at least 10 data pairs are used
- No adjustments are made for site pairs in different times zones

Methods

PM_{2.5} data for calendar year 1999 were extracted from AIRS on July 12, 2000.¹ The SAS statistical software was used to calculate the individual Pearson correlation coefficients for each set of paired sites. The equation for the correlation is:

$$r = \frac{\sum_{i=1}^n x_i y_i - \frac{\sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n}}{\sqrt{\left(\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n} \right) \left(\sum_{i=1}^n y_i^2 - \frac{\left(\sum_{i=1}^n y_i \right)^2}{n} \right)}}$$

where x and y represent the individual 24-hour average measurements from the paired sites.

¹ See Attachment A for a detailed description of the PM data used in these analyses.

Plots of the correlation vs. distance were made for each MSA for which data were available. No data were excluded for statistical significance, i.e. all correlations vs. distance were plotted. Distance between sites was calculated using the latitudes and longitudes of the each site pair and the equation:

$$distance = \arccos(\cos(lat1)*\cos(lon1)*\cos(lat2)*\cos(lon2) + \cos(lat1)*\sin(lon1)*\cos(lat2)*\sin(lon2) + \sin(lat1)*\sin(lat2))*R*Constant$$

where *lat1* and *lon1* are the latitudes and longitudes of the first site respectively and *lat2*, *lon2* are the latitudes and longitudes for the second site. *R* is the radius of the earth and the *constant* is the conversion factor to change miles to kilometers.

A total of 94 MSAs are included in this analysis. Electronic graphics files (*.gif) are contained in the attached CD-ROM. The file naming convention is "corgram2" followed by the MSA name and state abbreviation.

Discussion

The various plots for each MSA show that the correlation generally decreases linearly with increasing distance, such as in Chicago, Illinois. This would be expected since monitoring sites further away from each other may not be subject to the same sources or air masses. However, it is interesting to note variations from this general relationship. For example in Atlanta, Georgia, there are monitor pairs within the MSA that are not highly correlated. This could be indicative of monitoring measurements being influenced by nearby point sources.